APPENDIX A

BMP SPECIFICATIONS

BMP Specifications

1 – Forest Roads

The following is a simple list of recommended specifications for forest roads.

- Roads should follow contour as much as possible with road grades between 2% and 10%. Steeper gradients for up to 15% are permissible for up to 200 feet. By breaking or changing grade frequently, fewer erosion problems will result.

- On highly erodible soils, grades should not exceed 8%. Graveling the road surface can help maintain stability.

- Forest roads should be out-sloped whenever road gradient and soil type will permit. Out-sloping allows surface water to drain off the road quickly, reducing erosion potential.

- Use in-sloping when constructing a road where road gradients are greater than 10%, or toward sharp curves, or when constructed on clay and/or slippery soils. In such cases the use of an under-road culvert positioned at a 30° angle to ensure proper inside road drainage is recommended. The use of broad-based and rolling dips is encouraged to provide adequate drainage of the road surface.

- Intermittent or perennial streams, as well as certain ephemeral drains, should be crossed using bridges, culverts or fords. Cross as close to a right angle as possible. Structures should be sized so as not to impede fish passage or stream flow. (See pipe culvert sizing, pages 52 and 53.)

- Install water turnouts prior to a stream crossing to direct road water runoff into undisturbed areas of the streamside management zone. Road gradients approaching water crossings should be changed to disperse surface runoff water at least 50 feet from the stream. With the exception of stream crossings, roads should be located a minimum of 50 feet from any flowing or identifiable stream. Distance is measured from the bank to the edge of soil disturbance or, in case of fills, from the bottom of the fill slope.

- Where a road must be constructed or used within 50 feet of the stream, locate road as far away from the active channel as possible and surface the road section within 50 feet of the stream with material to create a non-erodible running surface. Cut banks and fill should be stabilized immediately using vegetation, rock, erosion blankets, or other suitable material. Install silt fence barriers at outlets of any drainage structures that are constructed.

- Where haul roads intersect highways, use gravel, mats, or other means to keep mud off the highway. (See Specification 21.)
- Install rip rap or other devices at the outlets of culverts and dips to absorb and spread water if needed.
- Use brush barriers or check dams as needed along roads and sensitive areas to filter sediment.
- Control the flow of water on road surfaces by keeping drainage systems open and intact during logging operations.
- Inspect roads at regular intervals to detect and correct potential maintenance problems.

2 – Skid Trails

Definition

An unsurfaced trail, usually single lane and occurring on a gradient steeper than a truck road. A skid trail is generally temporary in nature and is used to move the log or tree by either dragging or carrying, thus creating ground disturbance.

Purpose

A trail used to move logs and trees from the stump to the landing or concentration area.

Recommended Specifications

- Bladed or dozed skid trail grades should not exceed 25%. However, steeper segments may be required to avoid boundary lines, sensitive areas or other areas not accessible using skid trails of lesser grades. Allowances for skid trail grades of up to 35% for short segments can be acceptable. If steeper grades are necessary, practices must be used to prevent concentrated water flow that causes gullying. Skid trails should not be constructed on sidesteps exceeding 60%. If it is impossible to limit exposure of mineral soil, alternate systems should be considered such as extra cable length, cable yarding, or others.
- Overland and dispersed skidding on steep slopes should not exceed 35% or when bare soil areas provide potential for channelized flow.
- Avoid skidding in a streambed.
- Skid trails should be located outside the SMZ.
- Any skid trail that must cross a perennial or intermittent stream or drainage ditch should use a bridge or culvert of acceptable design. *Logs shall not be dragged through a stream of any type.*
- Skid trail crossings of any stream channel should be as close to a right angle as possible.
- Turn water out of skid trail at least 25 feet prior to stream crossing.
- Break grade frequently to avoid long, continuous stretches of the same grade.

- Rutting should be avoided whenever possible and especially where it causes channelized erosion. If rutting is unavoidable, concentrated skidding may be used to reduce the amount of disturbance. Site preparation should be used to ameliorate excessively compacted or rutted sites.

- Upon completion of skidding, areas subject to erosion should have water bars installed immediately. (See Specification 7.)

- A permanent vegetative cover should be established upon exposed soils that are greater than or equal to 5% slope, or less if soil type is highly erodible. (See Appendix D.)

- Temporary closeout of skid trails should occur if the skid trail will be inactive for periods longer than seven days or if a severe storm event is anticipated.

3 – Wing (Lead Off) Ditches

Definition

A water turnout, or diversion ditch, constructed to move and disperse water away from the road and side ditches into adjacent undisturbed areas so that the volume and velocity of water is reduced on slopes.

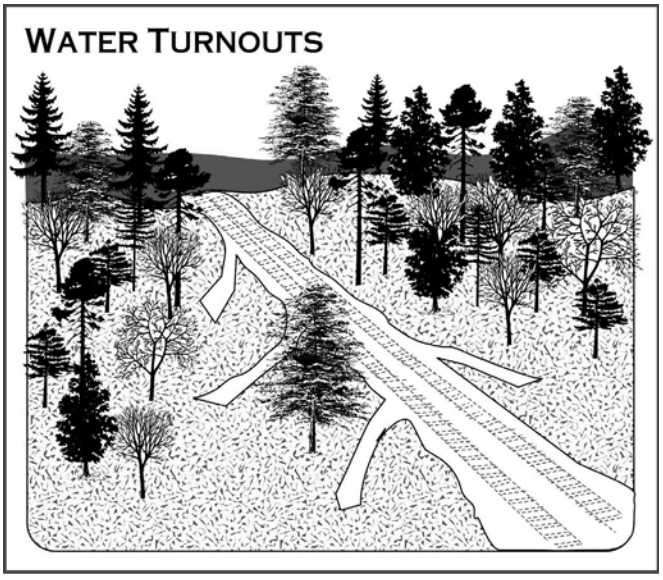
Purpose

To collect and direct road surface runoff from one or both sides of the road away from the roadway and into undisturbed areas.

Conditions where practice applies

- Any road or trail section where water could accumulate or accelerate. The water should be diverted onto undisturbed areas so the volume and velocity is reduced.

Recommended Specifications



Wing ditches should:

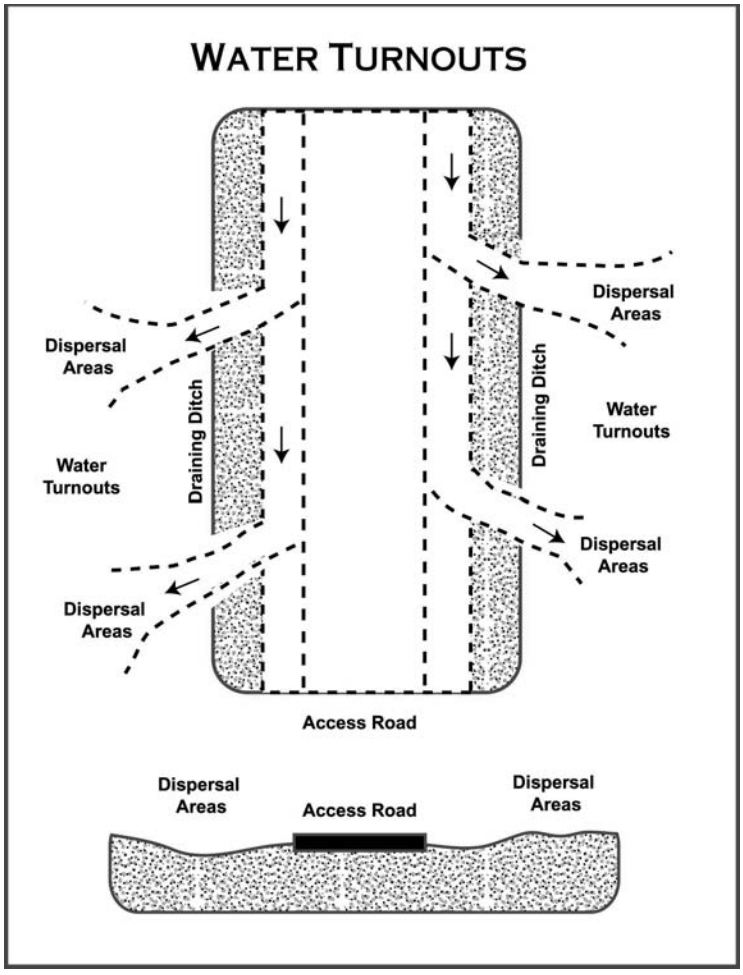
- Intersect the roadside ditch at the same depth and be outsloped to a maximum grade of 2%.
- Not feed directly into adjacent drainages, gullies or channels.
- Be installed or cut solidly into the soil and wide enough to allow maintenance with logging equipment, such as skidders.

On sloping roads, leave the road ditch line at a 30 to 45 degree angle to the roadbed and be downsloped less than 2% of the natural contour.

Wing ditches may be needed to provide outlets for other water control devices such as water bars and dips, but additional turnouts may also be needed along stretches of road where water is expected to collect. Topography and relief of the area will determine the spacing of wing ditches. Soil texture should also be considered for wing ditch spacing. On highly erodible or sandy soils, wing ditches (turnouts) should be spaced closer together than on clay soils.

Table 10
Maximum Distance Between Wing Ditches/Turnouts

	Slope (Percent)	Feet
Flat	2	250
	3	220
	4	190
	5	160
Moderate	6	144
	7	128
	8	112
	9	96
Steep	10	80
	11	60



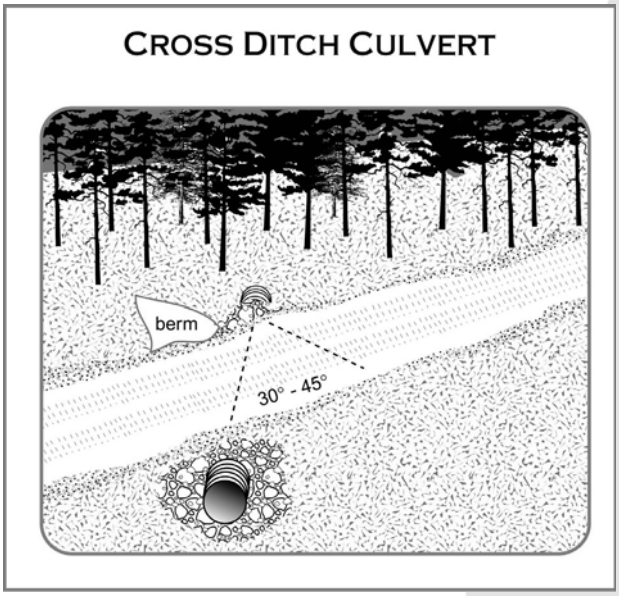
4 – Culvert Sizes for Cross-Drainage of Roads

Definition

Pipe made of metal, plastic or other suitable material installed under haul roads to transmit water from the roadside ditch, storm runoff, seeps and drains.

Purpose

To collect and transmit water safely from side ditches, seeps or natural drains under haul roads and skid trails without eroding the drainage system or road surface.



Conditions Where Practice Applies

- Culverts can be used for any operation where cross drainage of water is needed. In some cases, a culvert is necessary for temporary drainage crossings. Permanent installation should be periodically inspected for obstructions.

Recommended Specifications

- Pipe length should be long enough so both ends extend at least 1 foot beyond the side slope of fill material.
- The culvert should be placed 1% to 2% downgrade to prevent clogging and be laid so the bottom of the culvert is as close as possible to the natural grade of the ground or drain.
- The culvert should be angled 30 to 45 degrees across the direction of the road.

Erosion protection should be provided for outflows of culverts to minimize erosion downslope or downstream of the outfall; it may also be needed on the upstream end of culverts on flowing streams. This protection can be in the form of headwalls, rip rap, geotextile filter cloth, large stone, or prefabricated outflow and inflow devices.

Culverts should be firmly seated and earth compacted at least halfway up the side of the pipe. Cover equal to a minimum of half the culvert diameter (preferably 1 foot of fill per 1 foot of culvert diameter) should be placed above the culvert. Never use less than one foot of cover. The distance between pipes in a multiple culvert application should be a minimum of half the pipe diameter.

Spacing should be determined by the following formula: **Spacing = 400'/Slope + 100'**

Please also refer to the broad-based dip spacing table provided on page 140.

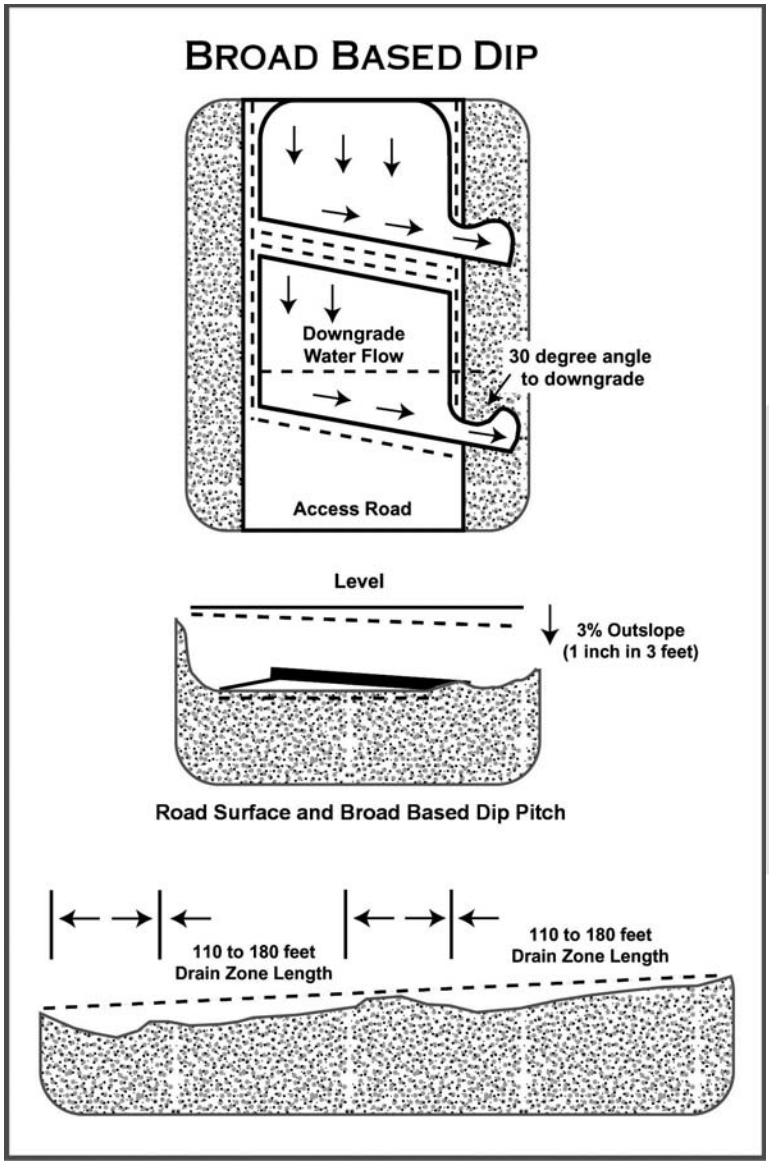
5 – Broad Based Dip

Definition

A surface drainage structure specifically designed to drain water from an access road while allowing vehicles to maintain normal travel speeds.

Purpose

To gather surface water and direct it off the road to prevent buildup of surface runoff and subsequent erosion while allowing the passage of traffic.



Conditions Where Practice Applies

- Used on truck haul roads and heavily-used skid trails generally having a gradient of 8% or less. Should not be used for stream crossings.

Recommended Specifications

- Installation should take place following basic clearing and grading for roadbed construction.
- A 20-foot, 3% reverse grade is constructed into the existing roadbed by cutting from upgrade of the dip location.
- The cross drain outslope will be 2% to 3% maximum.
- An energy absorber such as rip rap and, in some cases, a level area where the water can spread, should be installed at the outfall of the dip to reduce water velocity, thus minimizing erosion.
- On some soils the dip and reverse grade section may require bedding with three inches of crushed stone to avoid rutting the road surface.
- Broad-based dips are very effective in gathering surface water and directing it safely off the road. Dips should be placed across the road in the direction of water flow.

Table 11
Recommended Broad Based Dip Spacing

Road Grade (percent)	Distance Between Dips (feet)
2	300
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140
12	135